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Review of Face Recognition Techniques

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Abstract*— There is a crucial need for high security while accumulating data and information in abundantly manner. Biometrics is a technique in which individuals can be recognised automatically by using their metrics. Use of Biometrics and extensive acceptability for individual's verification has prompted numerous techniques. By employing biometrics, the authorization of person's individuality based on "who he/she is," rather than by "what he/she holds is possible. Face recognition has been a fast developing, interesting and rousing zone in real time applications. A huge number of recognition algorithms have been established in recent epochs. In this paper an effort is made to review an extensive range of present methodologies of face recognition techniques, algorithms and certain perceptions into the studies of machine recognition of faces have been presented. A number of distinctive appearance based, feature based and hybrid based approaches are discussed in this paper. Additionally, some efforts have been put to summarise the purpose for using face recognition, applications and certain difficulties, disturbing current techniques.

Keywords*—Artificial Neural Networks (ANN), Biometric system, Elastic Bunch Graph Matching (EBGM), Face Recognition, Hidden Markov Model (HMM), Independent Component Analysis (ICA), Local binary pattern(LBP), Linear Discriminant Analysis (LDA), Local phase quantisation(LPQ), Nearest Feature Space (NFS), Principal Component Analysis (PCA), Phase-Only Correlation (POC).

I. INTRODUCTION

In the advanced technological epoch, security issues are on the verge of risk as high rate of crimes under technical hands has been inclining with the passage of time. Therefore, it has become immensely important to find the alternatives. Security of individual is becoming need of the hour as password or pin methods are becoming more popular in this era, however, possessions can be lost, stolen or forgotten [1]. Recently, biometric technology has been introduced which allows the true recognition [2] of any individual on the behalf of their physiological and behavioural characteristics [3]. The several examples of biometric are face recognition voice identification and finger print etc. [1]. Face recognition is an application for automatically identifying or verifying an individual from an image. I t can be done by comparing the selected face features from the image database [4]. The face identification lies under the important part of domain object identification, in which researchers have shown interest from past years due to which it has become more popular [5]. One of the major problem in face identification systems is to recognise faces in different postures and in different lighting conditions [6].Whereas illumination difficulty was due to lightening effect on faces which cause variation in brightness, further, changes the facial features [5]. The main motives behind this concern are the inclusion of huge part of commercial applications in it where face recognition methods could be used for, simple login uses as well as for extraordinary safety control systems and where high accuracy is needed in the security surveillance. [7] In recent times, the major research focus is on video based face recognition and system combination. By creating new datasets the valuations of recognition methods using these records have been carried out. At the present, the face recognition has got a major place in the most dynamic applications of pattern recognition, image analysis. [8]
The rest of paper, section II describes biometric systems followed by the section III basics of face recognition. Section IV focus on various approaches for face recognition and section V depicts the face recognition algorithms followed by proposed work in section VI. Finally this paper is concluded in the section VII.

II. BIOMETRIC SYSTEM

A pattern-recognition structure which identifies individuals based on their feature vector resulting from their physiological and behavioural characteristic is basically a biometric system. The database is usually consist of feature vectors derived from individuals after being extracted. Biometrics derived from physiological characteristics are mostly more trustworthy than behavioural characteristics in biometric systems, even if within certain precise applications the latter may be more easy to execute. [9]

A. Practical requirements [3]

Universality: characteristics should be compulsory for every individual.
Distinctiveness: two persons should have the different characteristic.
Permanence: there should be invariant characteristics over a period of phase.
Collectability: measurements of different characteristics can be obtain quantitatively

B. A biometric system is designed using the following four main modules [10] shows in Fig. 1

i. Sensor module: in which biometric data of person is captured.
ii. Feature extraction module: in this the developed biometric data is processed to taking out of features gained from the developed biometric data.
iii. Matcher module, in this module the extracted features are matched with the stored data and matching scores are generated.
iv. System database module: in this module biometric patterns of the enrolled individual is stored. For enrolling process of a person into the biometric structure datasets the enrolment module is used. Firstly, the biometric characteristics of a person are scanned to gain a digital illustration and then a quality check is done to assure the proper process. additionally feature extractor is used to produce a template

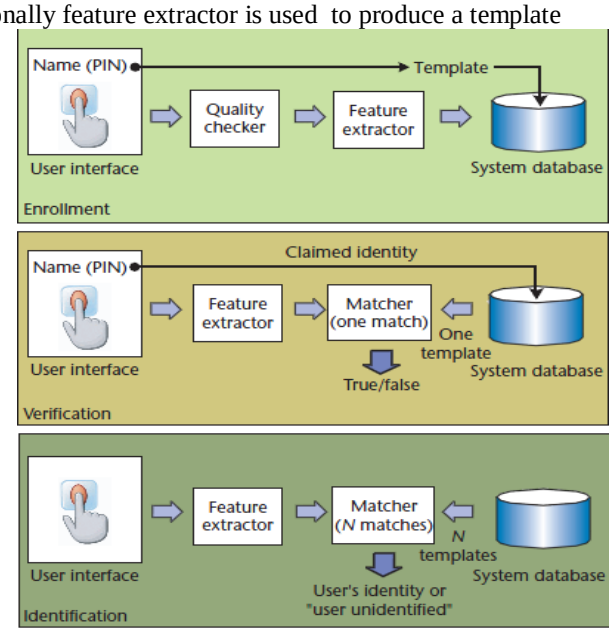

Figure 1: Biometric system

C. Applications

commercial applications, include computer system logins, physical access control, electronic records safety, e-commerce, automated teller machine, credit cards, , mobile phones, government applications such as nationwide identification card, passport control, communal security, border security, driving licenses and criminological applications such as body identification, criminal examination, assassin documentation, and lost children. [10]

III. BASICS OF FACE RECOGNITION

A. Face Recognition

Face Recognition is one of the most biometrics authentication techniques from the past few years. Face recognition is an motivating and effective presentation of Pattern recognition and Image analysis. Human recognition can be done with the numerous biometric features like fingerprint, signature, iris, palm print face, hand geometry, gaits, speech. Face recognition shows great recognition or identification rate of better than 90% for massive face datasets with well-controlled position and brightness situations. [11]

An automatic face recognition (AFR) structure is made of three portions: face detection followed by face alignment and face recognition., face detection provides the information about place of faces, face alignment discovers the main feature vector of faces, and lastly face recognition describes the face of an individual.

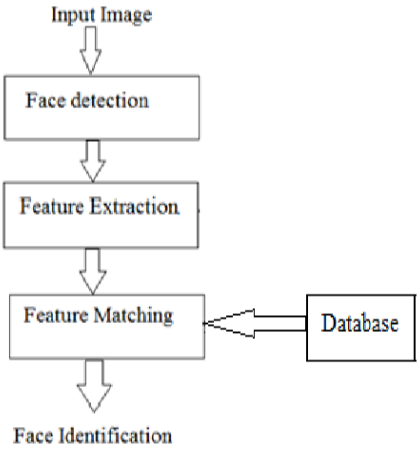

Figure. 2: Face Recognition System [1]

Face recognition mainly identifies an already spotted face as an acknowledged or strange face. Face recognition and face detection are theoretically dissimilar in meaning. The main task of ace detection is to identify an individual as a face, whereas face recognition is a process which decides if this face‟ is somebody acknowledged or strange depending on the datasets of faces. [1]

B. Challenges in face recognition [1]

i. Even though current machine recognition systems have reached a certain level of perfection but still there are many real application conditions which limits their good performance.
ii. 3D head posture variations are some inevitable difficulties which appear in the range of practical applications, because people cannot be always frontal to the camera
iii. Illumination: dissimilarities because of the internal camera control and skin reflectance properties.
iv. Facial expression: Faces suffer from great deformations beneath extreme facial expressions and becomes difficulties for the algorithms
v. Occlusion: it occurs Due to extra objects or accessories (e.g., scarf, sunglasses etc.) and can affect the presentation of face recognition algorithms.
vi. Time Delay: Human face changes with passage of time. The changes including, presence or absence of facial hair, makeup, hair style, and muscle tension, expression of the skin, glasses, aging effects and facial jewellery affect the most.

C. Applications of face recognition

Face recognition delivers many applications of image analysis. For example, Automated crowd surveillance, mug shot identification; access control Eyewitness faces restoration; Designing of human computer interface (HCI). In Multimedia communication, the artificial generation of faces can be obtain by this techniques. In video indexing faces can be labelled in video by using existing structures. Face recognition systems using human face are currently an active exploration range with the purpose to accomplish vigorous and trustworthy biometric identification and displays improved results and benefits over additional biometrics modalities such as, fingerprint, iris, gait, speech, and ear recognition. The major benefit of face is that it can be taken from some distance. [1]

IV. VARIOUS APPROACHES FOR FACE RECOGNITION

There are basically three approaches for face recognition

Feature base approach

In feature centred method the segmentation of local features like eyes, nose is done and further it is used as input records in face detection task which helps in to easier the assignment of face recognition.

Holistic approach

In holistic method face recognition is done by taking the whole face at the input part in the face detection task.

Hybrid approach

Hybrid method is mixture of holistic approach and feature based. In this method both whole and local face is taken at the input of face detection structure

A. Appearance Based Approaches

1. The Eigenface Method

The Eigenface technique is one of the mostly used process for face recognition. Karhunen Loeve is based on the eigenfaces technique in which the Principal Component Analysis (PCA) is used. This technique is effectively used to achieve dimensionality decline. Face recognition and detection mostly use Principal Component. Mathematically, Eigenfaces are the principal components through which into feature vectors can be obtained from the face. The feature vector data can be attained as of covariance matrix. These Eigenvectors are used to calculate the difference between numerous faces. The faces are categorized by the linear grouping of maximum Eigenvalues. Every face can be measured as a linear grouping of the eigenfaces. The face, having the largest eigenvalues of the eigenvectors can be approximated. [11] Eigen face is an applied method for face identification. Execution of an Eigen face recognition scheme has become easy because of the ease of its algorithms. The accuracy of Eigen faces rest on numerous things. The Eigen face method finds an approach to make ghost-like faces that characterise the bulk of variance in an image dataset. This method is built on an evidence theory method that decomposes face pictures into a minor set of feature images called “Eigen faces”, which are in fact the principal components of initial training set. The problem of Eigen face is, it is profound for lightening environments and location of the Head. Drawback is outcome of the eigenvalues and eigenvectors are phase consuming. [12]

2. Principal component analysis (PCA)

Principal component analysis is a flexible reduction process. It is valuable when individual has gained data on a number of variables (a large number of variables), consider that there is certain redundancy in those variables. In this case, redundancy shows that certain variables are associated with one another; perhaps they are evaluating the similar perception. Because of this redundancy, it is believed that it should be imaginable to decrease the detected variables into

a reduced amount of principal components (artificial variables).The system is centred on an information theory method that decomposes face pictures into a minor set of characteristic feature images called 'Eigenfaces', which are in fact the principal components of the original training set of face images. A significant feature of PCA is that an individual can rebuild any original image from the training set by joining the Eigenfaces. The system used in making Eigenfaces and using them for recognition is also used separate of facial recognition. This method is also used for handwriting examination, voice recognition, lip reading, medical imaging analysis and hand gestures clarification. [13]

a. Steps for PCA: [12]

i. To perform PCA several steps are undertaken:

ii. Pre-processing: before detection of face, pre-processing and classification is needed. Input image is in RGB layout is then transformed in Grey image.

iii. Mean Image: the mean image need to be calculated for the proper working of the PCA.

iv. Covariance Matrix: Calcutations must be done to find the covariance matrix.

v. Eigen vector and Eigen value: from covariance matrix Eigen vector and Eigen value can be calculated.

vi. Euclidian Distance: The Euclidian distance computes among Eigen values of input image and dataset image.

After the calculating Euclidian distance, it is compared with the database and match is declared, weather the individual present in dataset or not. After calculating the Euclidian distance the system identifies the face and name of the individual. If the Euclidian distance of input image matches then the person is certified else person is not permitted.

a. Advantages of PCA

i. Recognition is simple and effective.

ii. Data compression is attained by the little dimensional subspace depiction.

iii. Raw intensity statistics are used openly for learning and recognition without any major low-level or mid-level Processing low-level or mid-level processing.

iv. No information of geometry and reflectance of faces is compulsory

b. Disadvantages of PCA

i. The technique is very profound to scale, therefore, a low-level pre-processing is l essential.

ii. Its recognition rate falls for recognition beneath changing posture and lighting.

iii. The problem can be more challenging when, great change in posture as well as in appearance occurred.

iv. Learning is very slow, which makes it tough to modernize the face dataset.

3. Fisherfaces

Fisherfaces is one the best successful extensively used technique for face recognition. It is based on holistic method. The fisherface method for face recognition uses both principal component analysis and linear discriminant analysis which creates a subspace projection matrix, as used in the eigenface technique. Though, the fisherface technique is capable of taking benefit of within-class information, minimising variation within each class, but still maximising class separation. Like the eigenface construction procedure, the first stage of the fisherface method is to take every (NxM) image array and redesign into a ((N*M) x1) vector. Fisherface is similar to Eigenface but with improvement of improved classification of dissimilar modules image. With FLD, individual can categorise the training set to contract with different persons and different facial look. Better accuracy in facial expression than Eigen face method has been obtained by FLD and Fisherface eliminates the first three principal components because of which light intensity varies [11].

4. Linear Discriminant Analysis (LDA)

LDA is another algorithm commonly used for data classification and dimensionality reduction, specifically in cases where, within-class frequencies are unequal and their performances have been tested on random datasets. LDA promises supreme separability between classes by exploiting the proportion of between-class variance to within-class variance. The main difference between LDA and PCA is that PCA is focused of feature classification while LDA is focused on data classification. In PCA, when the original data is transformed to a different space its shape and location changes, whereas in LDA the location does not change but more class separability is provided [14].

a. Advantages of LDA

i. The LDA is meant to solve the lighting problem by exploiting the relation of between-class scatter to within-class scatter.

ii. LDA based systems overtake PCA centred ones, because LDA enhances the low dimensional depiction of the objects with attention on the most discriminant feature extraction while the latter attains only object reconstruction. [13]

b. Disadvantages of LDA

i. it flops when all scatter matrices are singular.

ii. However, a serious concern using LDA, mainly in face recognition area, is the Minor Sample Size (SSS) Problem.

5. Independent Component Analysis (ICA)

Independent Component Analysis ICA can be reflected as simplification of PCA and is claimed to have more representative power than PCA. A linear transformation is discovered by ICA to express a set of random variables as linear combinations of statistically free of root variables. It was claimed that for face recognition additional important

information is existing in extraordinary order of statistics. Therefore, ICA was employed to extract the features. ICA encodes face images with statistically independent variables. These variables are not necessarily associated with the orthogonal axes and looks for direction that are most independent from each other. ICA de-correlates the high-order moments of the input in adding to the second-order instants and it's likely to be used for face recognition. There is a necessity to implement face recognition scheme using ICA for facial images having face orientations and diverse lighting situations. The independent components are calculated from the PCA outcome Eigen vector matrix and make the matrix as square by decreasing the dimensions of the matrix. The feature vectors matrix comprises of the independent components are additionally used in the classification procedure. The Euclidian distance classifier finds the distance between the input testing image and the recognized training dataset images. If the distance between these two images is small we say that the two images are same otherwise the images are different. [15]

6. Support Vector Machines (SVM)

Support vector machines (SVM) are used to develop the classification presentation of the PCA and LDA subspace features. Supervised learning is generally used to train the SVM classifiers. A training set of images is used by the SVM to calculate the Optimal Separating Hyper plane (OSH), and reducing the risk of mis-classification between two classes of image in some feature space. A binary tree classification technique for face recognition has been used in which a face image is considered as belonging to one of two classes. A binary tree structure is propagated up till the two classes signify separate subjects and a final classification decision can be prepared. SVM has been engaged for face recognition by some other investigators and has been exposed to yield worthy outcomes. [1]

B. Feature based approaches

i. Feature – based Approach

The geometric features such as width and position of nose, eyes, mouth and eyebrow's thickness have been first extracted to represent a face in feature base approaches. Like facial features other facial marks have been also extracted. Then geometric relationship has been computed among those facial points. Using these observations, standard statistical recognition approaches has been employed to match faces. Appearance based techniques give good results than feature based method. Benefits of using feature based schemes has been included high speed matching. [16]

ii. Hidden Markov Model (HMM)

The first efforts to use Hidden Markov Model (HMM) were introduced by Samaira and Young. HMM has been worked effectively for images with variations in brighting, facial expression, and orientation. Thus, it has an advantage over the appearance based approaches. For processing images using HMM, the temporal or space sequences has been considered. HMM has been defined as a set of finite states with associated probability distributions. The reason why it is named Hidden Markov Model is that the states are not visible and only the result is visible to the external user. The HMM based methods have been used strips of pixels that cover the forehead, nose, mouth, eye, and chin without finding the exact locations of facial features. The face structure has been viewed as a sequence of discrete parts. The order of this sequence should be conserved for e.g., it should run from top to bottom from forehead, mouth, eyes, nose, and chin. [17]

iii. Elastic Bunch Graph Matching (EBGM)

All People faces possess an alike topological structure. The real face images have a lot of non- linear characteristics such as variations in brightness, pose and expression and show differences in presence in various scenarios. These variations cannot be represented by the linear analysis. So, Wiskott has been presented a face recognition method using elastic bunch graphs. Basically, faces have been represented as graphs with nodes positioned at fiducial points such as Eyes, nose etc. The edges have been labelled with 2D distance vectors with each node contained a set of 40 complex Gabor wavelet coefficients at different levels and orientations (phase, amplitude). They are called "jets" and the recognition has been based on labelled graphs. Elastic bunch graph matching (EBGM) has been used model graph to represent a human face and encoded local presence using 'wavelet jets'. A Gabor wavelet transform has been created a dynamic link architecture that projects the face onto an elastic grid. Basically, the Gabor jet has a node on the elastic grid, denoted by circles on the given image. The behaviour of image is defined by these nodes around a specified pixel and also signifies the frequencies at a particular image pixel. The outcome gained is obtained by convolving the image with gabor filter and which is further used for shape detection and can be used to extract features using image processing. A convolution mergers the functions together and states the quantity of overlap from functions. [18]

iv. Neural Networks Approach

A successful face recognition procedure relies deeply on the specific choice of the features employed by the pattern classifier. Neural based Face recognition is vigorous and has improved performance of greater than 90% acceptance ratio. The Back Propagation Network (BPN) is commonly used learning algorithm in training multilayer perceptron (MLP). The MLP refer to the network which consist of a set of sensory units (source nodes) that composed of the input layer, one or additional hidden layers of computation nodes, and an output layer of computation nodes. The input signal spreads through the network in a forward direction, from left to right and on a layer-by-layer basis. Artificial neural networks are algorithms that can be employed to execute nonlinear statistical modelling and offer a new another way to logistic regression, the normally used technique for developing predictive models for dichotomous results in medicine. Neural networks propose a number of benefits, including needing less formal statistical training. [19-20]

a. Advantages of BPN

i. This BPNN offers a computationally effective technique for fluctuating the weights in feed forward network, with differentiable initiation function components, to learn a training set of input-output data.

ii. It decreases the overall squared error of the output calculated by the net.

iii. The combination of BPNN with PCA shows the ratio more than 90 % and execution time of only few seconds.

b. Disadvantages of BPN

i. It is a slow procedure.

In case of Radial basis function RBF, it comprises of 3 layers (input, hidden, output) Input layer made up of nodes that associate network to surroundings. At input of every neuron (hidden layer), distance among neuron centre & input vector is computed. RBF (Gaussian bell function) is applied to form outcomes of the neurons. Output layer is linear and delivers reaction of network to activation function. RBF is an artificial neural network, which uses radial functions as activation functions. The value of RBF depends only on the distance from the origin. RBF networks are appealed to be extra precise than those based on Back- Propagation.

C. Hybrid Methods

These methods has been used both holistic and feature-based methods to recognize the face and has given the better results. Many hybrid methods have been included Modular Eigen modules and Eigen faces, which used for both global Eigen faces and local Eigen features and shows much better results than the holistic Eigen faces. Penev and Atick have been proposed a method called Hybrid LFA (Local Feature Analysis). Lanitis has been proposed a Shape-normalized Flexible appearance models and Component-based Face region and components has been proposed by Huang, which have been based on component recognition combination and face recognition by 3D morphable models. The first step is to generate 3D face models using 3D morphable model from the three input images of each person in the training. These images have been used to train a component-based face recognition system [50]. Based on Support Vector Machine (SVM) recognition system has been used which decomposes the face into a group of components that are interconnected by a flexible geometrical model so that it can account for the changes in the head pose leading to changes in the position of the facial components. However, the main limitation of the component-based system had the need of a large number of training images taken from different viewpoints and under different lighting conditions which has not been available in many real world applications. So, to eliminate these limitations 3D morphable models had been incorporated. [1]

V. FACE RECOGNITION ALGORITHMS

A. Local binary pattern (LBP)

Basically, the local binary pattern (LBP) had been designed for texture description. It has extended more and more researchers' and faculties' attention for its computational effectiveness and high discrimination property but also it has been invariant to monotonic grey-scale transformations which is very important for texture analysis. Besides that, the possibility of processing image in real-time has been enabled by its computational simplicity which outperforms many other texture descriptors. [23] LBP is one of the most effective local feature extractors, which extracts texture features of the picture by comparing each pixel with its closest in a small neighbourhood. Moreover, there is no training requirement, which makes it fast and easy to integrate into the new data sets. Furthermore, because of the application of histograms as the feature sets, it has robust against rotation and scaling. [21] Also, the image-size dimension can be reduced to the number of histogram bins. Since the grey values of neighbours have been compared, it is robust against monotonic fluctuations in the face image. Thus, LBP is one of the brightness insensitive descriptors. The procedure of the LBP-based face recognition algorithm is very simple. First, the face region has been detected, the feature points on the face have detected, and then the scale, rotation and translation have normalized according to the position of feature points. Next, LBP has been calculated for each local block image. Finally, the matching score has been calculated using the weighted Chi square distance between histograms of LBPs. [22]

Different steps of LBP

i. Radius of two neighbouring windows and number of neighbours

ii. Binary patterns obtained by comparison between the center pixel and its neighbours.

iii. Utilising binary codes to make the histograms and concatenate them for each image sub-block LPQ. [23]

B. Local Phase Quantisation(LPQ)

LPQ is a widespread histogram-based feature extractor which belongs to the family of local texture descriptors, and performed the assessment of phase in a local window at the pixel position. In frequency domain, Local phase analysis has been led to a detailed brightness insensitive texture description of face images. LPQ has been also insensitive against image degradation, blur effect, which happens usually in real world applications, such as video surveillance, which has been caused by out of focus of camera or object motion. LPQ has a common brightness and blur insensitive feature extractor. To use local phase quantization for face description, it can be applied for the procedure of face recognition. [24] First the face image has been labelled with the LPQ operator. Then, the label image has been divided into non-overlapping rectangular regions of equal size and a histogram of labels has been computed independently within each region. Finally, the histograms from different regions have been concatenated to build a global description of the face. LPQ procedure has been given below [23]

i. STFT at four specific frequencies included a small window at the pixel position

ii. Finding the real and imaginary coefficients for the four frequencies

iii. Based on the sign of real and imaginary values, Binary quantisation has been done

iv. A histogram has been conducted based on the 8-bit stream.

C. Phase-Only Correlation (POC)

Phase-Only Correlation (POC) has been also called phase correlation, which has one of the image matching techniques and has been successfully implemented to biometric authentication and computer vision difficulties. The POC function has been defined as the inverse Discrete Fourier transform of the normalized cross power spectrum. The height and position of the correlation peak has been indicated the similarity and translational movement between images, respectively. The algorithm using POC has been proposed for the face recognition. The POC-based face recognition algorithm has been followed very simple procedure. First, the face image has been normalized as well as the rest step of the LBP-based face recognition algorithm. Next, a set of the reference points has been positioned on the face image to evaluate the local block similarity. The phase-based correspondence matching has been used, the corresponding point pairs are obtained, where the corresponding point pair having low similarity value has been eliminated as an outlier. Finally, the matching score has been calculated as the number of correct corresponding point pairs. If the image has occluded region, the matching score of the POC matching has been decreased even for the genuine pair. [22]

D. Local binary Patterns & Nearest Feature Space (LBP&NFS)

The simple and efficient Local Binary Patterns (LBP) technique and Nearest Feature Space (NFS) classifier that the good generalization ability has combined to construct a new approach for satisfying the real-time and robustness decision performance. The face image database derived from web has been used for experiments. The practical results show that the prototype method performs better than traditional methodologies in terms of real-time efficiency (0.7s per image) and accuracy (72.5% Average Recognition Rate) Nearest Feature Space (NFS) was first demonstrated by Jen Tzun and implemented in face recognition. Essentially, it has been an extension of closest neighbour (NN) because it has been accommodated a larger capability of prototype features by extending the geometrical aspects of point and point to point and space. Practically, it has been tackle with distance between testing feature point and its projection feature point in expanded feature space according to the geometrical concepts. As NFS shows priority than nearest feature plane (NFP) and nearest feature line (NFL) by Chien concluded that it has been only focused on the NFS-related methods. The proposed work has been used Local Binary Pattern (LBP) and Nearest Feature Space (NFS) which has been an extension of multi decision level combination based on combined features for face recognition techniques. For pre-processing of images, the histogram equalisation (HE) method has been used to eliminate illumination effect because using the existing approaches to face recognition. Tthe illumination normalization has been performed irrespective of the brightening conditions then the two features are combined, the LBP has been used to extract further feature on DCT-Scharr-image. Then Nearest Neighbourhood (NN) classifier has been to finding N numbers of the optimum candidates. The course- to fine structure has been divided into the coarse stage and the fme stage. So, by the end of this stage called the coarse step and can eliminated a lot of no-good samples in the Training Databases and decrease the scope to identity the test image of the N optimal candidates. Finally, the use of more powerful advanced LBP again and the more robust generalization ability of Nearest Feature Space (NFS) to get the identity of the test image. The NN extension of the NFS enlarges the prototype capacity from searching the nearest feature point to the nearest distance between query and prototype space. The NFS not only enlarge the prototype of NN, and increase the capacity of generalization but also the suitable limited number of candidates situation is optimum for full playing the performance of the NFS. Conclusively, adding to this part decision-level fusion part, we combine both feature-level fusion and decision-level fusion serially to form the novel effective and real-time face recognition method. Experimental results with average recognition rate (ARR) of 76% and 0.7s per image of real-time efficiency have been yield based on the Celebrity Database. [25]

E. Local binary Pattern & Local Phase Quantisation (LBP&LPQ)

A local-based brightness insensitive algorithm has been mostly used for face recognition which has the arrangement of image normalisation and brightness invariant descriptors. The Illumination insensitive demonstration of image has been obtained based on the ratio of gradient amplitude to the original image intensity and divided into smaller sub-blocks. Local phase quantisation and Multi-scale local binary pattern, extract the sub-blocks characteristics. Distance of local nearest neighbour classifiers has been measured and fused at the score level to find the best match and decision-level fusion combines the results of two matching techniques combining feature extractors can result in better performance than employing one descriptor. Among the local descriptors with significant performance, LBP and LPQ have known to been computationally fast with simple calculations which are insensitive against monotonic image degradation. [23]**]**The comparison of various face recognition algorithms on the basis of their accuracy and different set of data base is shown below in table 1.1.

Table 1.1 Recognition rate for the proposed algorithm and comparison of algorithms using different database.

S. No.	**1**	**2**	**3**	**4**	**5**
Algorithm	**LBP**	**LPQ**	**POC**	**LBP & NFS**	**LBP& LPQ**
Database	**YALE**	**YALE**	**FERET**	**ORL**	**YALE**
Accuracy (%)	**96.97 %**	**95.3 %**	**96 %**	**72.5 %**	**98.3 %**

VI. PROPOSED WORK

After surveying various face recognition techniques, fusion of LBP and LPQ shows the acceptable results as the results obtained by fusion of local binary pattern (LBP) and local phase quantization (LPQ) are found to be the efficient as compared to other techniques .the accuracy of the proposed algorithm varies between 95 percent to 100 percent. The basic steps for the proposed algorithm are shown in Fig. 3

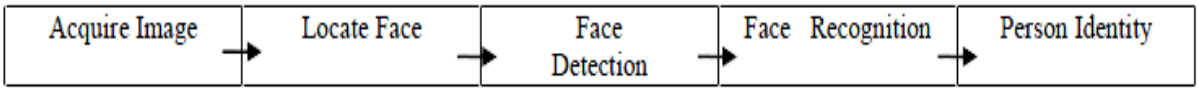

Figure 3: steps for proposed algorithm

VII. CONCLUSIONS

Face recognition has recently become a very dynamic and motivating research zone in the area of image processing and computer vision. Vigorous research has been accompanied in this range for the past epochs and enormous progress with inspiring results has been gained. The motive of this paper is to provide a review of significant number of papers to cover the recent growth in the zone of face recognition. Present face recognition systems have already grasped an assured level of maturity when functioning under controlled environments but for superior face recognition new algorithm has to develop using hybrid approaches to resolve the problems regarding, time-delays, illumination, occlusion, facial expressions and pose orientations. The various algorithms and techniques have been discussed in this paper for face recognition on the basis of their accuracy and their respective database. From the comparison, it can be concluded that the fusion of linear binary pattern and local phase quantisation (LBP&LPQ) provide better results for face recognition. Therefore, future work could be done by fusing the LBP and LPQ with the voice recognition techniques for further enhancement in field of biometric security systems The list of references is provided to gain more complete understanding.

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